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HEWLETT PACKARD COMPANY
P O BOX 272400, 3404 E. HARMONY ROAD
INTELLECTUAL PROPERTY ADMINISTRATION
FORT COLLINS, CO 80527-2400

EXAMINER

KIELIN, ERIK J

ART UNIT PAPER NUMBER

2813

DATE MAILED: 06/03/2003

23

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/492,557

Applicant(s)

ANTHONY, THOMAS C.

Examiner

Erik Kielin

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 March 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 34-42 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 34-42 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

This action responds to the Amendment filed 28 March 2003 (Paper No. 22).

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) do not apply to the examination of this application as the application being examined was not (1) filed on or after November 29, 2000, or (2) voluntarily published under 35 U.S.C. 122(b). Therefore, this application is examined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

2. Claims 34-36, 38, 40, and 41 are rejected under 35 U.S.C. 102(b) as being anticipated by US 5,748,524 (**Chen** et al.) considered with the text Introduction to the Theory of Ferromagnetism by **Aharoni**, Clarendon Press: Oxford, 1996, p. 16.

Regarding claims 34, 40, and 41, **Chen** discloses a magnetic memory comprising a memory cell comprising a sense layer/reference layer 21/23, 41/43, tunnel barrier 22, 42 (instant claim 40) and a stabilizing (i.e. keeper) structure 30, 55 which is formed of a soft or hard ferromagnetic material (col. 4, lines 58-63; col. 6, lines 5-10) formed adjacent to the sense layer

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(instant claim 41) with an easy axis --in the case of the soft magnetic material-- or a magnetized axis --in the case of the hard magnetic material-- oriented perpendicular to the easy axis of the sense layer and accordingly parallel to the edge regions of the sense layer; a shape that provides flux closure: a path for magnetic flux transport between a pair of opposing edge regions of the sense layer (col. 4, lines 41-44); and prevents disruptions (e.g. demagnetization fields) to the magnetization state 11 in the sense layer. (See Figs. 5-8; columns 3-6.)

Exchange coupling between the keeper structure and the sense layer necessarily occurs because the end regions are pinned by the keeper structure. Note that “exchange” and “exchange energy” are defined in the text Introduction to the Theory of Ferromagnetism by **Aharoni**, Clarendon Press: Oxford, 1996, p. 16, to be the existence of a force for aligning the spins of unpaired electrons i.e. aligning the magnetic moments. Accordingly, the ferromagnetic coupling is necessarily an example of “exchange coupling” by definition of exchange and exchange energy.

Regarding claim 35, **Chen** shows that the flux closure path between the edge regions prevents overall magnetization in the sense layer from straying from parallel and antiparallel orientations with respect to the easy axis of the sense layer.

Regarding claim 36, the keeper structure 30, 55 has an easy axis which is substantially perpendicular to the easy axis of the sense layer, as noted above.

Regarding claim 38, the keeper structure is formed from a permeable ferromagnetic material (NiFe or NiFeCo; col. 2, lines 4-10). Note the instant specification at p. 11, 13-17 states that this is the material of the keeper structure.

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3. Claims 34, 37 and 39 are rejected under 35 U.S.C. 102(e) as being anticipated by **Hurst** et al. (US 5,956,267).

Hurst discloses an MRAM array wherein each memory cell includes the sense layer / tunnel layer / reference layer stack, 70, (Fig. 8, column 6, lines 27-42); the stabilizing structure “keeper” (30 in Figs 6-8; in the trench in Figs. 9-13 but not labeled; column 5, lines 27-47) formed of a magnetically permeable ferromagnetic material which (1) has a U-shape (Figs. 9-13) which runs along the wordline and therefore along plural memory cells (Abstract); (2) has a shape and proximity to the sense layer that provides flux closure: a path for magnetic flux transport between a pair of opposing edge regions of each sense layer; (3) inherently prevents disruptions to the magnetization state in each sense layer by specifically “directing demagnetization fields away from the edge regions;” and (4) applies a magnetic field to a set of edge regions by exchange coupling, that is **perpendicularly oriented** to the easy axis of each sense layer **in the absence of an electric current flowing** through the wordline. (See especially Fig. 16 which shows the magnetic flux **only while current is flowing** through the wordline; column 7, lines 6-15.)

As further evidence that the easy axis of the keeper structure in **Hurst** is along the length direction of the keeper structure and accordingly perpendicular to the easy axis of the sense layer, see Applicant’s specification, page 7, 1st paragraph. This paragraph indicates that the magnetic field lines orient in the same manner as in **Hurst** when a current is flowing through the wordline (i.e. according to the right hand rule or around the wordline, just as shown in Fig. 16 of **Hurst**) and therefore perpendicular to the shown direction **in the absence of current**, just as in Applicant’s disclosure. If the magnetic field in the keeper 120 aligns as shown in Fig. 16 of

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Hurst, “[u]pon application of current in the wordline 120” (column 7, lines 9-10) it is clear that the alignment is **not** as shown in it the absence of the current, which means it behaves as in the instant application and would result in a “substantially perpendicular” orientation to that orientation while current is flowing through the word line.

See *In re Swinhart*, 169 USPQ 226,229 (CCPA 1971) (where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that subject matter shown to be in the prior art does not possess the characteristics relied on) and *In re Fitzgerald*, 205 USPQ 594 (CCPA 1980) (the burden of proof can be shifted to the applicant to show that subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 USC 102 or obviousness under 35 USC 103).

Regarding claims 37 and 39, **Hurst** shows the keeper structure is formed in a U shape which encases the read/write conductors (i.e. the word line) (Figs. 13 and 16).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 34, 37, and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Hurst** considered with **Chen**.

If it is thought that the structure in **Hurst** does not inherently provide the magnetization or easy axis of the stabilizing (keeper) structure to be substantially perpendicular to the easy axis of the sense layer, then this may be a difference.

Chen teaches the benefits of stabilizing the ends of the sense layer substantially perpendicular to the easy axis of the sense layer, by using either soft or hard ferromagnetic material which is ferromagnetically coupled, i.e. ferromagnetically exchange coupled to the ends of both the sense layer and the reference layer by virtue of direct contact therewith. (See **Chen** col. 4, lines 10-11, 41-44, and 58-63; col. 6, lines 5-10. Compare to Applicant's specification, page 8, line 26 to page 9, line 4 and page 9, lines 18-24.)

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a soft or hard ferromagnetic material to stabilize the magnetization of the edge regions of the sense layer in **Hurst** in a direction perpendicular to the easy axis of the sense layer and to use a hard ferromagnetic material as taught by **Chen** for the beneficial reasons indicated therein, because stabilized end regions improves the magnetic memory over one which does not have stabilized end regions, as taught in both **Hurst** and **Chen**.

Alternatively, the prior art of **Chen**, as explained above, discloses each of the claimed features except for indicating that the keeper structure is in a U shape which encases the read/write conductors (i.e. the word line).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to modify the structure of **Chen** to form the U-shape of **Hurst**, for the reasons indicated in **Hurst**, at least at col. 7, lines 6-15, to more effectively concentrate the magnetic field above the

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word line than could be obtained by a keeper structure no formed in a U shape and encasing the word line.

6. Claim 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Chen** in view of US 5,587,943 (**Torok et al.**).

The prior art of **Chen**, as explained above, discloses each of the claimed features except for indicating if the memory cells have square outer dimensions.

Torok shows that a typical magnetic memory cell has square outer dimensions as a result of the intersection between the wordline and bitline which is square. (See Figs. 9, 11, 12A, 12B, 13, and 14.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to form the **Chen** memory cell in a square shape as taught by **Torok** because **Torok** teaches that this is standard shape for a memory cell. Moreover, one of ordinary skill would be motivated to use the square shape formed by the intersection between the wordline and bitline in order to form an array of memory cells on a single chip, as shown in **Torok**.

Response to Arguments

7. Applicant's arguments filed 28 March 2003 (Paper No. 22) have been fully considered but they are not persuasive.

Applicant's cancellation of claims 43 and 44 obviate the rejection under 35 USC 112(1) of said claims.

Applicant argues in the first paragraph of p. 4,

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“Applicant respectfully submits that claim 34 is not anticipated by Chen. Claim 34 is a magnetic memory having a sense layer and a keeper structure that provides a flux closure path between a pair of edge regions of the sense layer. Chen does not teach or suggest a keeper structure which provides a flux closure path between the edge regions of a sense layer as claimed in new claim 34. Instead, Chen discloses a memory cell 20 having a separated pinning material 30 disposed on each edge of a memory cell 20 (see Figs 5 and 6 of Chen). It is submitted that the disconnected pinning material 30 does not provide a flux closure path as claimed in claim 34. Applicant therefore submits that claim 34, and therefore claims 35-42 which depend from claim 34, are not anticipated by Chen.”

Examiner respectfully disagrees that Chen fails to disclose “a keeper structure which provides a flux closure path between the edge regions of a sense layer.” While Chen does not use Applicant’s terminology, Chen is not required to. Chen states at col. 4, lines 41-44,

“Generally, it is desirable to pin magnetic end vectors 28 and 29 in an orientation substantially perpendicular to the length, or parallel to width W so as to reduce the end effect and at least partially **close the magnetic loops**.” (Emphasis added.)

Because the “magnetic loops” are the magnetic field lines --i.e. magnetic flux path-- the magnetic flux path is closed. Accordingly, Chen discloses this limitation.

Applicant argues in the next paragraph on p. 4 that Examiner has made an obviousness type rejection over Chen in view of Aharoni. Examiner respectfully submits that this allegation is in error. Aharoni is provided as evidence that the Chen pinning structures 30 inherently possess the feature of exchange coupling. MPEP 2131.01 states,

“Normally, only one reference should be used in making a rejection under 35 U.S.C. 102. However, a 35 U.S.C. 102 rejection over multiple references has been held to be proper when the extra references are cited to:

- (A) Prove the primary reference contains an ‘enabled disclosure;’
- (B) Explain the meaning of a term used in the primary reference;

or

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(C) Show that a characteristic not disclosed in the reference is **inherent.**" (Emphasis added.)

In this case, since Aharoni was provided only for the purpose of evidence for a showing of inherency, no obviousness rejection was made.

Applicant argues in the last paragraph on p. 4,

"The Examiner has rejected claims 34, 37, and 39 under 35 U.S.C. §102(e) as being unpatentable over Hurst. Applicant respectfully submits, however, that claim 34 is; not anticipated by Hurst because Hurst does not disclose a keeper structure for applying magnetic fields using exchange coupling to a pair of edge regions of a sense layer as claimed in claim 34. Instead, Hurst discloses a structure 30 that is separated from a bit region 70 by a dielectric layer 60. (See Figs 7-8 and col. 6, lines 23-25 of Hurst). Applicant therefore submits that claim 34, and therefore claims 37 and 39 which depend from claim 34, are not anticipated by Hurst."

Examiner respectfully disagrees that "Hurst does not disclose a keeper structure for applying magnetic fields using exchange coupling to a pair of edge regions of a sense layer" for the reasons indicate in the rejection which are included herein. Flux path closure is shown in Figs. 14-16. The dielectric layer 60 does not block the magnetic flux path. Similar macroscopic examples are (1) the aligning of iron filings along the magnetic field lines of a magnet separated by a dielectric of paper, or (2) the distortion of cathode ray tube (e.g. a television) by holding a magnet up to the thick dielectric glass surface, or (3) the warning signs around a magnetic resonance imaging source (MRI) that a person with a pacemaker --implanted inside the human body-- stay away because the magnetic field penetrates through the dielectric of space and air. Direct contact is absolutely not required for flux path closure. Moreover, Hurst uses the terminology "magnetic field keeper" which clearly has the same purpose as does Applicant's "keeper structure." Hurst states in col. 7, lines 32-47,

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“In most cases, the **magneto-resistive material has edge domains that are magnetized in a particular direction** regardless of whether the incident magnetic fields is applied ... Accordingly, it is contemplated that a reset line of a magnetic field sensor device may include the above-described **magnetic field keeper** to increase the magnetic field produced by the reset line at the magnetic material of the sensor device.” (Emphasis added.)

Because the edge domains are magnetized in a particular direction by the keeper structure in Hurst, exchange coupling necessarily exists for reasons shown to be inherent by the Aharoni reference.

Applicant argues in the first paragraph on p. 5,

“The Examiner on pages 5-6 of the Office Action mailed 1121-02 expends considerable effort in speculating on the orientation of the easy axis in the structure taught by Hurst. Applicant submits that claims 34, 37, and 39 do not recite any limitations regarding easy axis orientations in a keeper structure.”

While Examiner agrees that Hurst does not “recite” any limitations regarding the easy axis orientations, Examiner respectfully points out that Hurst is not required to in order to anticipate the feature. As long as the feature is implicit or inherent, it need not be expressly disclosed. (See MPEP 706.02, section entitled, “Distinction Between 35 USC 102 and 103.”) For the reasons indicated in the rejection above, the perpendicular orientation of the easy axis is at least inherently if not implicitly taught.

Further regarding all of Applicant’s arguments regarding the rejection of the claims anticipated by each of Chen and Hurst, MPEP 2145 states that “argument does not replace evidence where evidence is necessary.”

Applicant repeats the argument in the second paragraph on p. 5 that neither of Chen and Hurst discloses or suggests the keeper structure claimed. Examiner repeats the response above.

Applicant argues in the third paragraph on p. 5,

“It is also submitted that Hurst does not teach or suggest a combination with Chen and that Chen does not teach or suggest a combination with Hurst. It would be impermissible hindsight based on an applicant's own disclosure to combine the pinning material of Chen with the structure of Hurst.”

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

In the last paragraph on p. 5, Applicant repeats the argument that the claims do not “contain a limitation that the easy axis of the keeper structure is substantially perpendicular to the easy axis of the sense layer.” While this is noted, Hurst alone or Hurst in view of Chen still teach or suggest all of the features of claims 34, 37, and 39, for the reasons already indicated in the rejections above.

In the first paragraph on p. 6, Applicant finally argues that because Chen does not teach the claimed keeper structure that Chen in view of Torok does not teach the limitations of claim 42. Because Chen does, in fact, teach the claimed keeper structure, this argument is moot. Applicant does not address the limitation of claim 42.

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For at least these reasons, Applicant's arguments are not found persuasive.

Conclusion


8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.


Erik Kielin
May 31, 2003